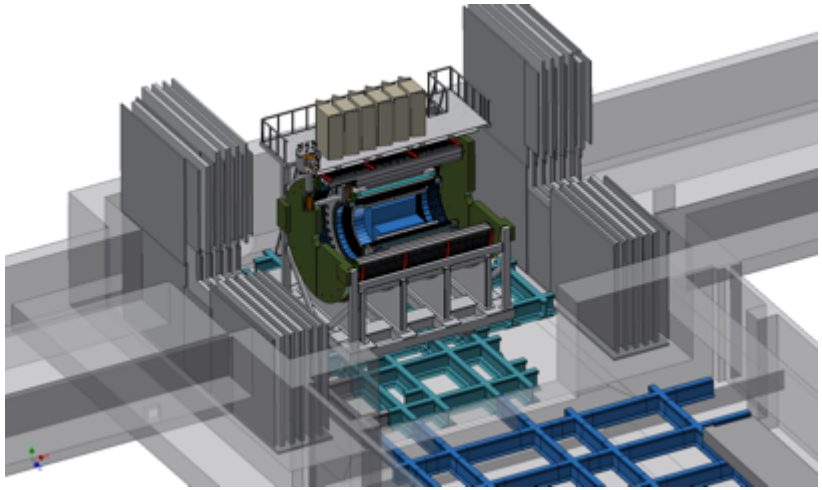
sPHENIX Engineering Installation and Integration

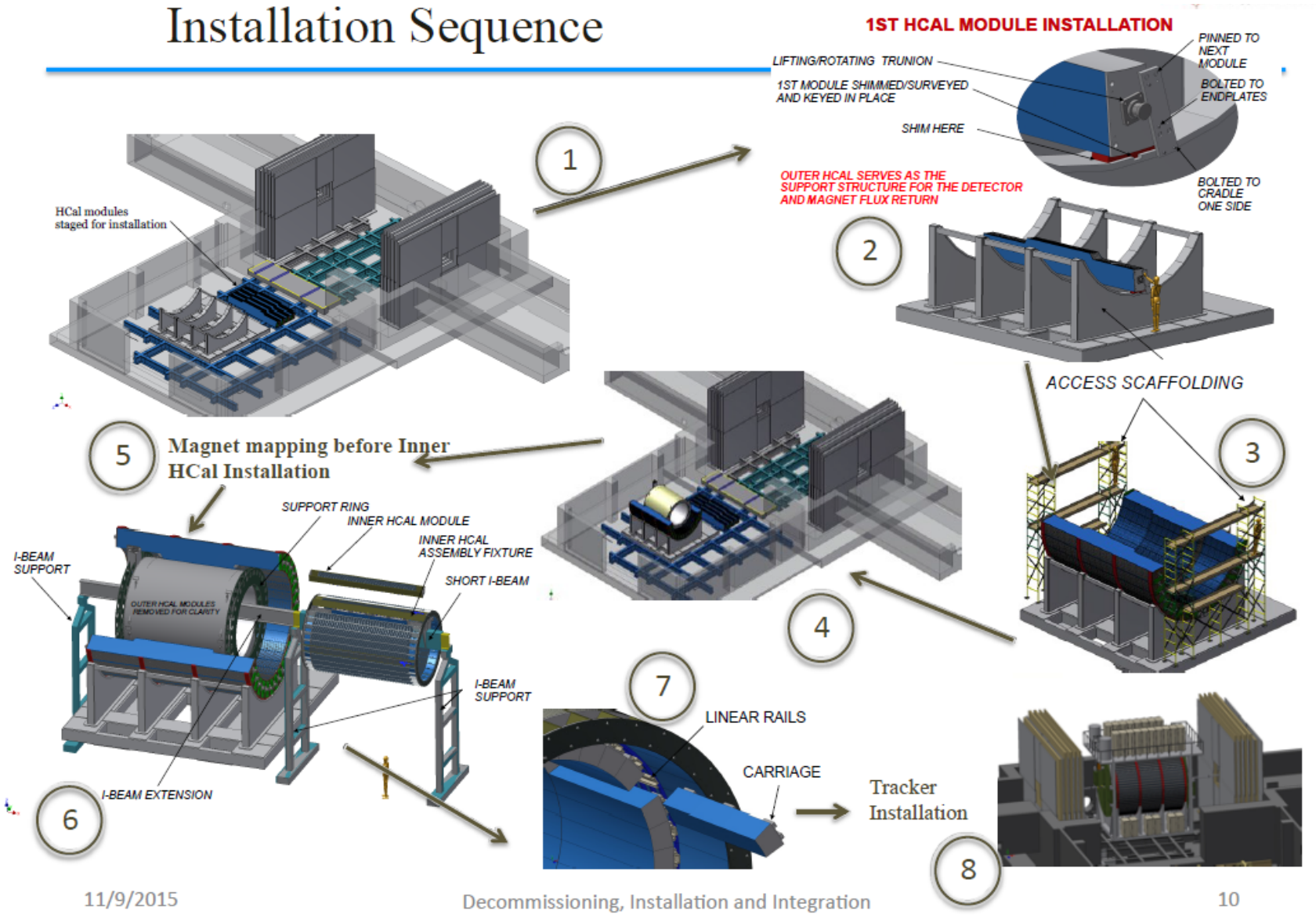


Engineering Effort

sPHENIX currently has ~ 20 engineers working working on designs, R&D and prototyping for:

- **Decommissioning**
- **Magnet**
- **Detector subsystems (both mechanical and electronic)**
- **Integration**
- **Installation**
- **Infrastructure**
- **E, S & H**

Installation Plan



Specifications/Requirements: sPHENIX Integration and Installation

- IR & AH Floor Loading Limits: 4000 psi, max
- Positional precision: 0.5 mm,
  Angular precision: 10 milliradian (roll, pitch and yaw)
- Installation to be accomplished in the Assembly Hall (40 ton and 5 ton overhead cranes)
- Assembly to be prepared for magnet mapping in Interaction Region (IR) after Outer HCal is installed, then returned to Assembly Hall to complete detector installations.
- Overall size requirements The complete sPHENIX assembly, including magnet valve box stack and all electronics racks, must fit through the sPHENIX sill on the existing sPHENIX rail system

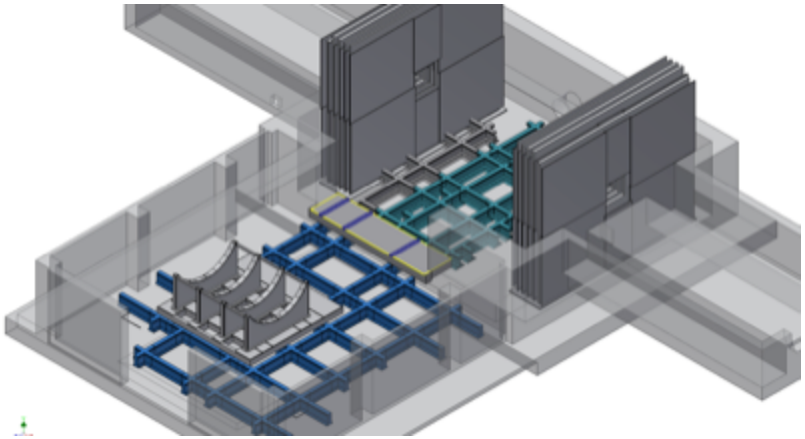
sPHENIX Assembly and Installation Tooling and Fixtures

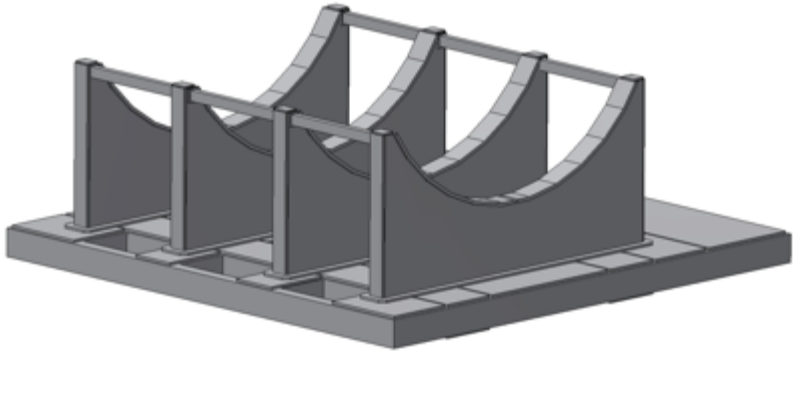
We have identified all of our significant tooling needs:

- **Central Pedestal (CP)**: (standard lifting tools for CP base and rollers, cradle, support posts, bridge, access stairs), alignment tools for rollers and cradle.
- **Outer HCal**: module holding fixture (4), indexed lifting/installation fixture, alignment tools, temporary inner & outer support assembly fixtures
- **Inner HCal**: module holding fixture (4), module lifting fixture, assembly indexed/ rotating fixture and insertion beam and insertion beam lifting fixture, alignment tools
- **EMCal:** module handling fixture (8), rail alignment tool, indexed lifting/ installation fixture
- **Tracking**: Handling fixture (2), alignment tool, installation tool
- **SC Magnet**: Lifting fixture (spreader bar), alignment tool, stack handling/lifting tool
- **Infrastructure**: beampipe alignment tools/fixtures, bakeout tools/fixtures

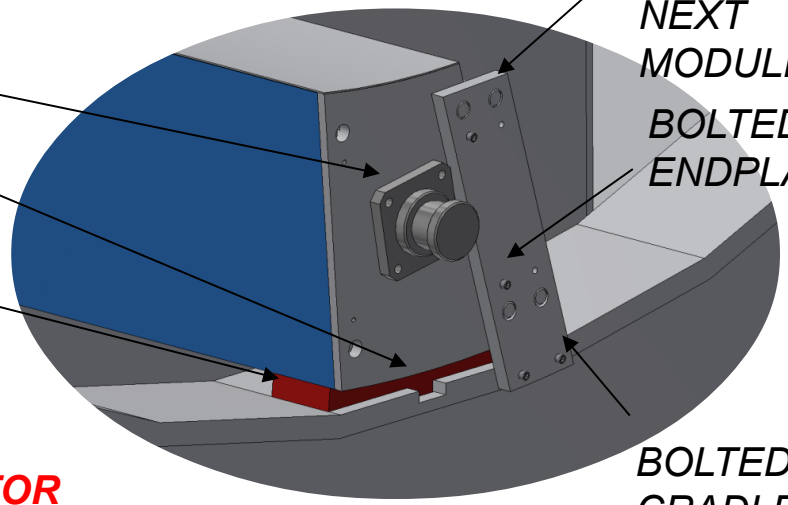
Install the Central Pedestal (CP) Base

- Gather and stage CP Base components (base platform sections, Hillman Rollers, X-Y alignment details, cradle arcs)
- Assemble lower platform
- Install and position cradle arcs and cross members
- Survey cradle arcs, adjust alignment and indexing, weld in place
- Position, align and install Hillman Rollers

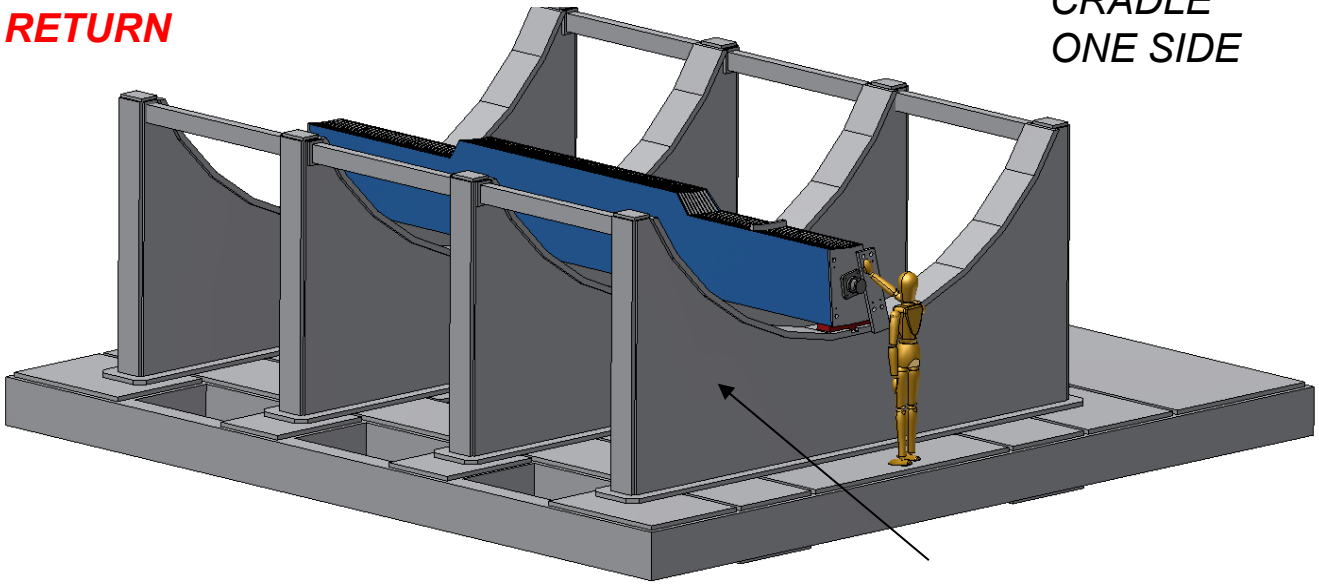




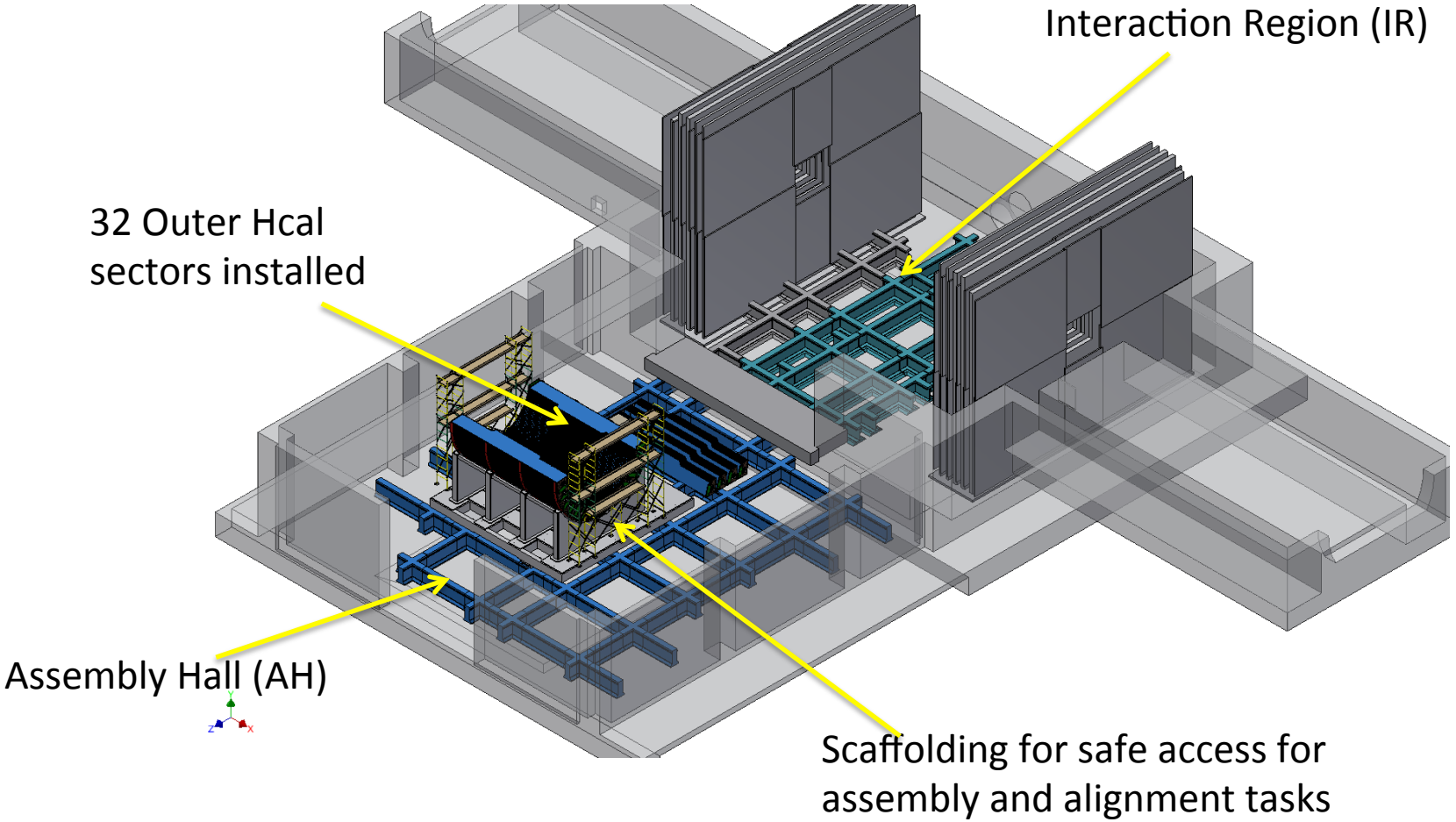
1ST HCAL MODULE INSTALLATION



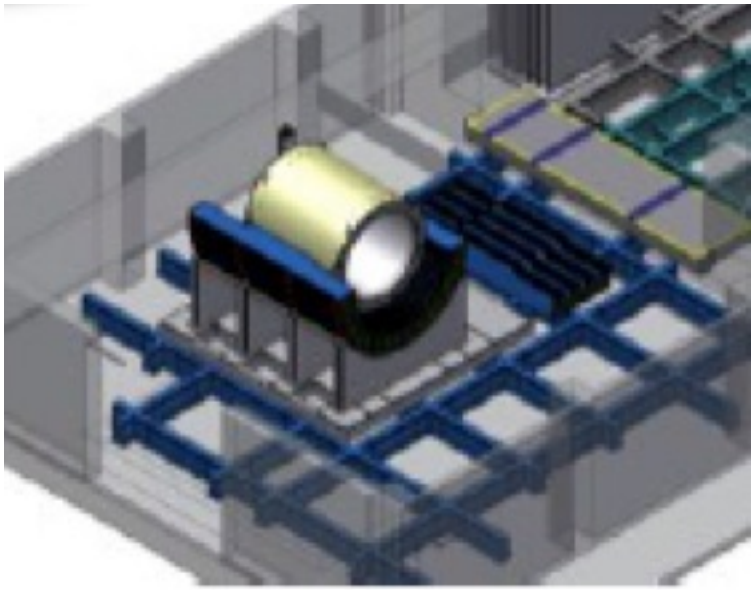
OUTER HCAL SERVES AS THE SUPPORT STRUCTURE FOR THE DETECTOR AND MAGNET FLUX RETURN



Install the Lower Half of the Outer HCal



Magnet Preparation and Installation

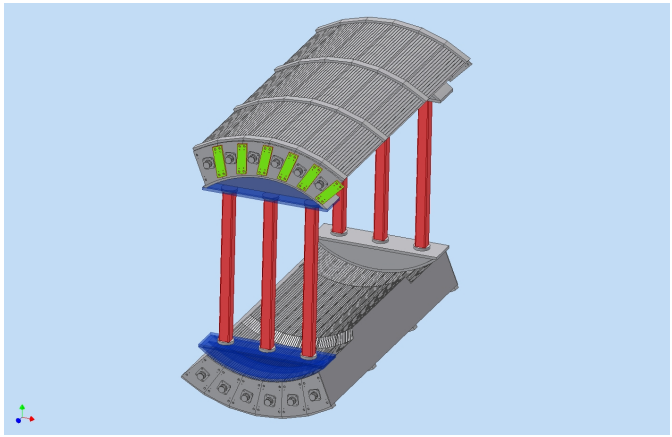


- Install SC-magnet inside of bottom 1/2 of Outer HCal cylinder.
- Rotate into proper position

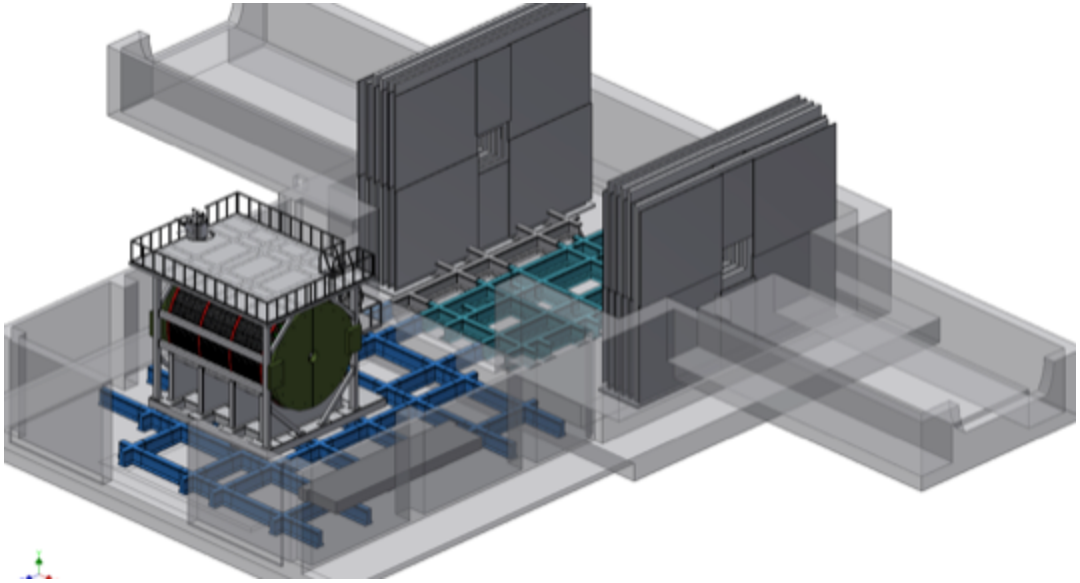
Eventual service to SC-magnet.

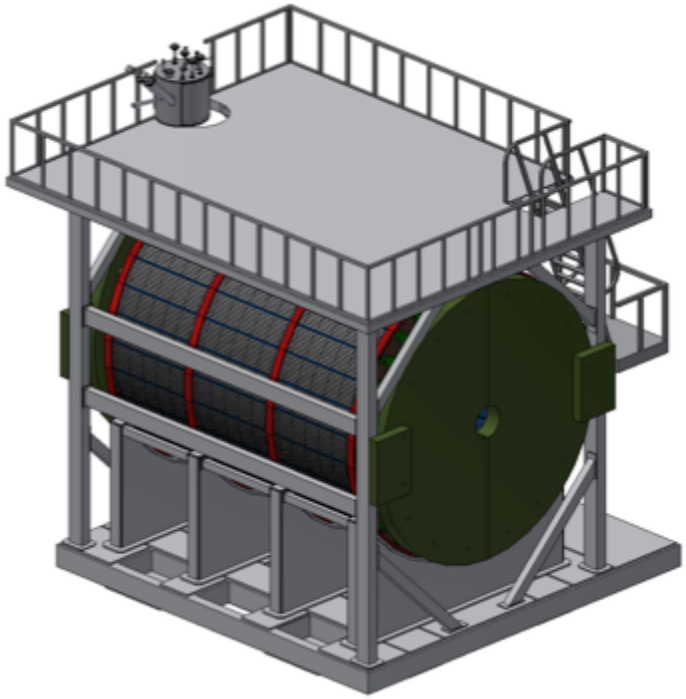
- Provide DC Power Supply that is compatible with the requirements of the coil (4596A @ 20V -> 1.5 T Central Field);
- Provide a Magnet Quench Detection System, Dump Resistor, and Switch;
- Provide an operating Cryogenic System with associated support equipment (i.e. Turbo Vacuum Pump, Cryogenic Lines and Connectors, Controls and Communications, Pressure Relief Devices and Lines, Cryogenic Transfer Lines)
- Provide a Magnet Mapping Device and measure the magnetic field

Install the rest of the Outer HCal, Upper Platform & Magnet Stack

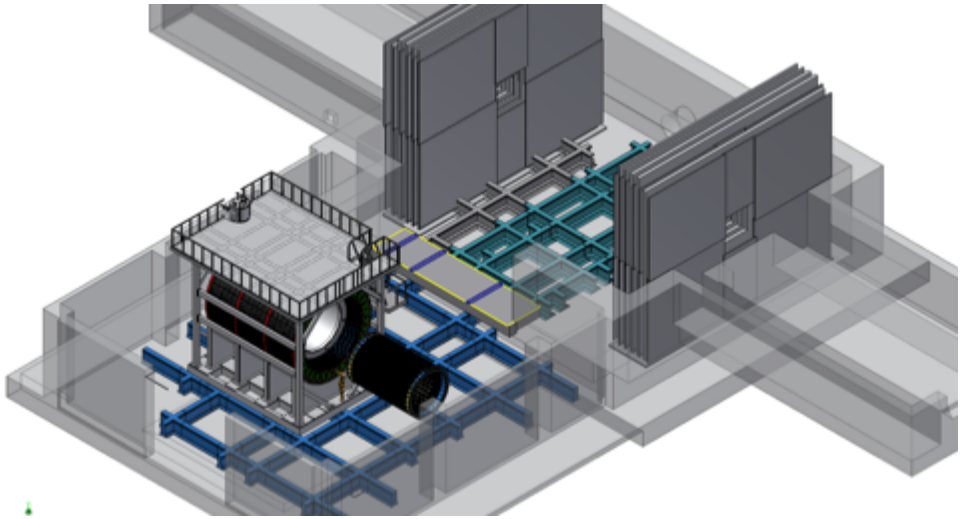


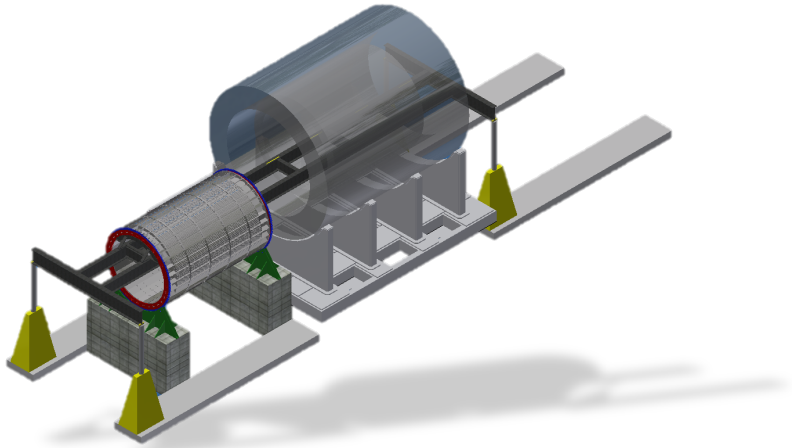
- Install upper platform support columns and bracing
- Install SC magnet Stack
- Install Flux return End Caps
- Into IR for Magnet mapping/Test then Back to AH



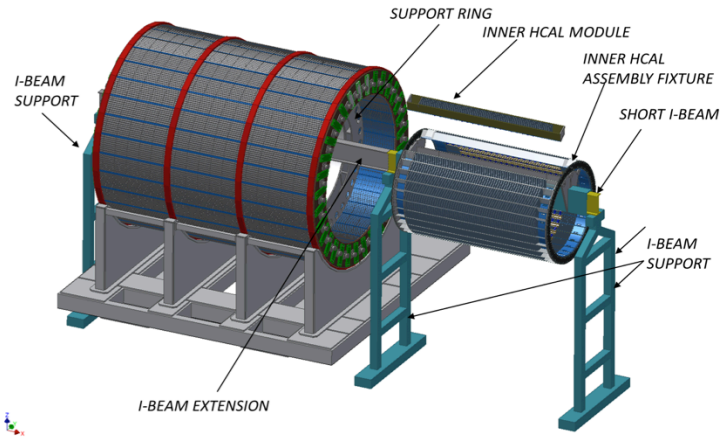


Inner HCal



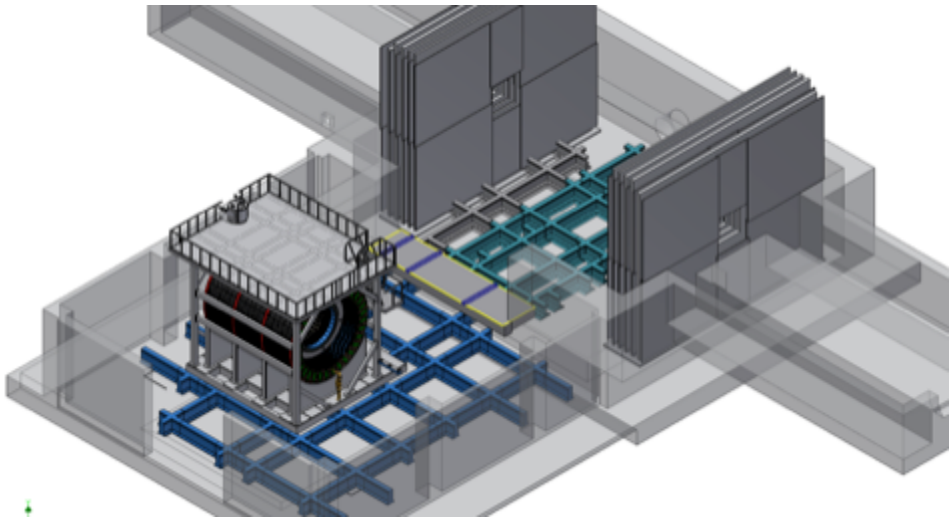


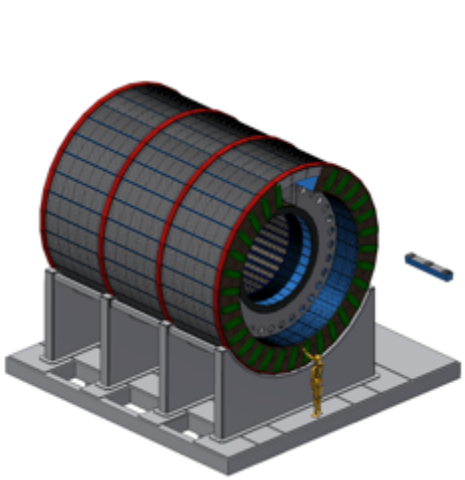
- Transport Inner HCal completed modules to AH
- Test to make sure electronics are intact after transport
- Assemble Inner HCal in rotating assembly fixture 1 module at a time
- Final adjustments and lock
- Install Inner HCal mounting supports
- Install beam extension
- Install the full Inner Hcal, align and attach to the Inner HCal mounting supports.
- Install patch panels, cables, and route to racks
- Test all connections

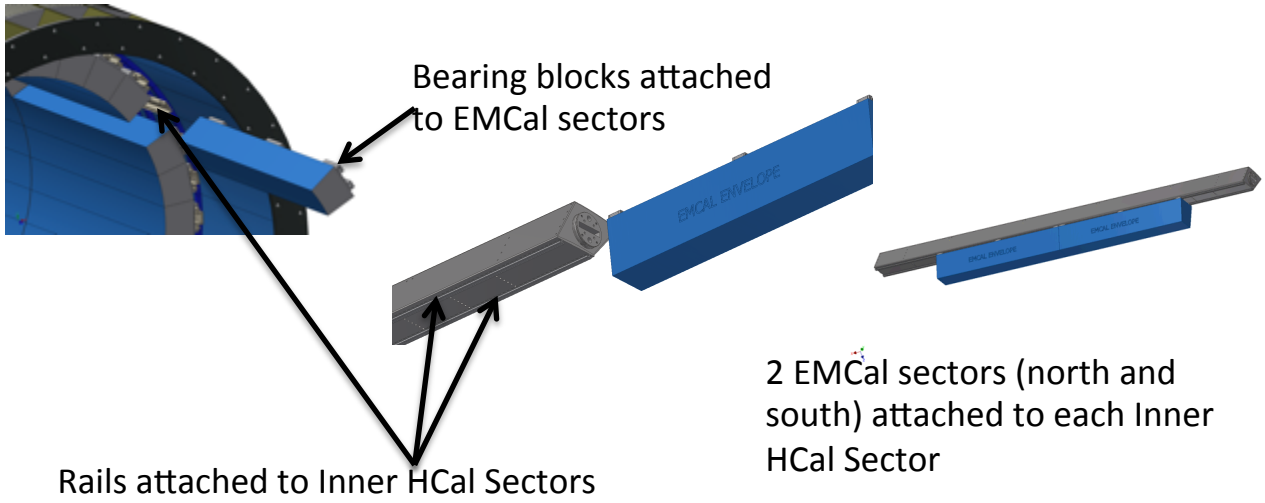


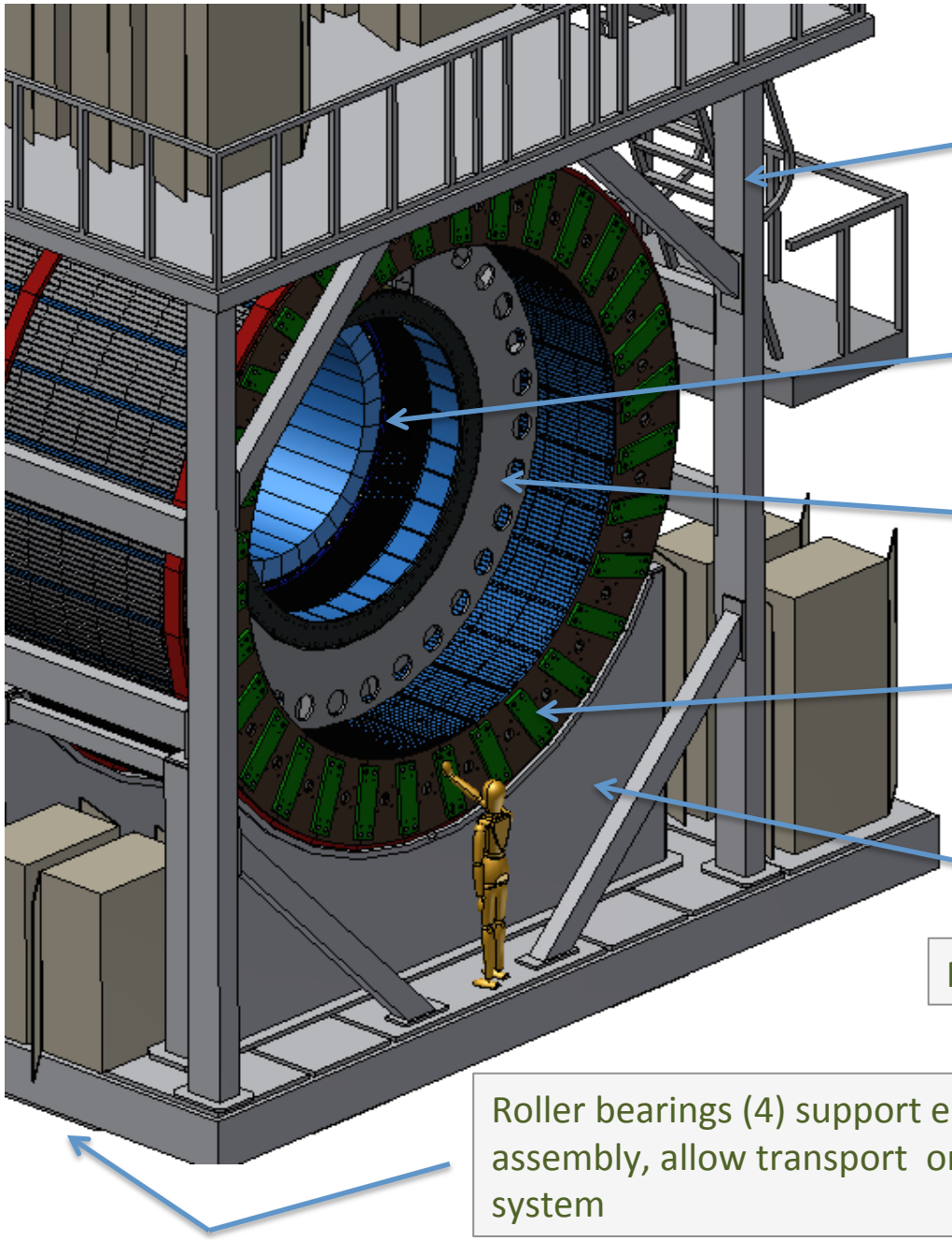
EMCal

- Transport modules to AH
- Test to make sure electronics are intact after transport.
- One by one Insert and align the 32 south EMCal modules using the indexed insertion tool.
- Repeat for north side
- Make final alignment adjustments and secure and lock all modules in place.
- Install patch panels, cables, services and route to racks
- Test all connections

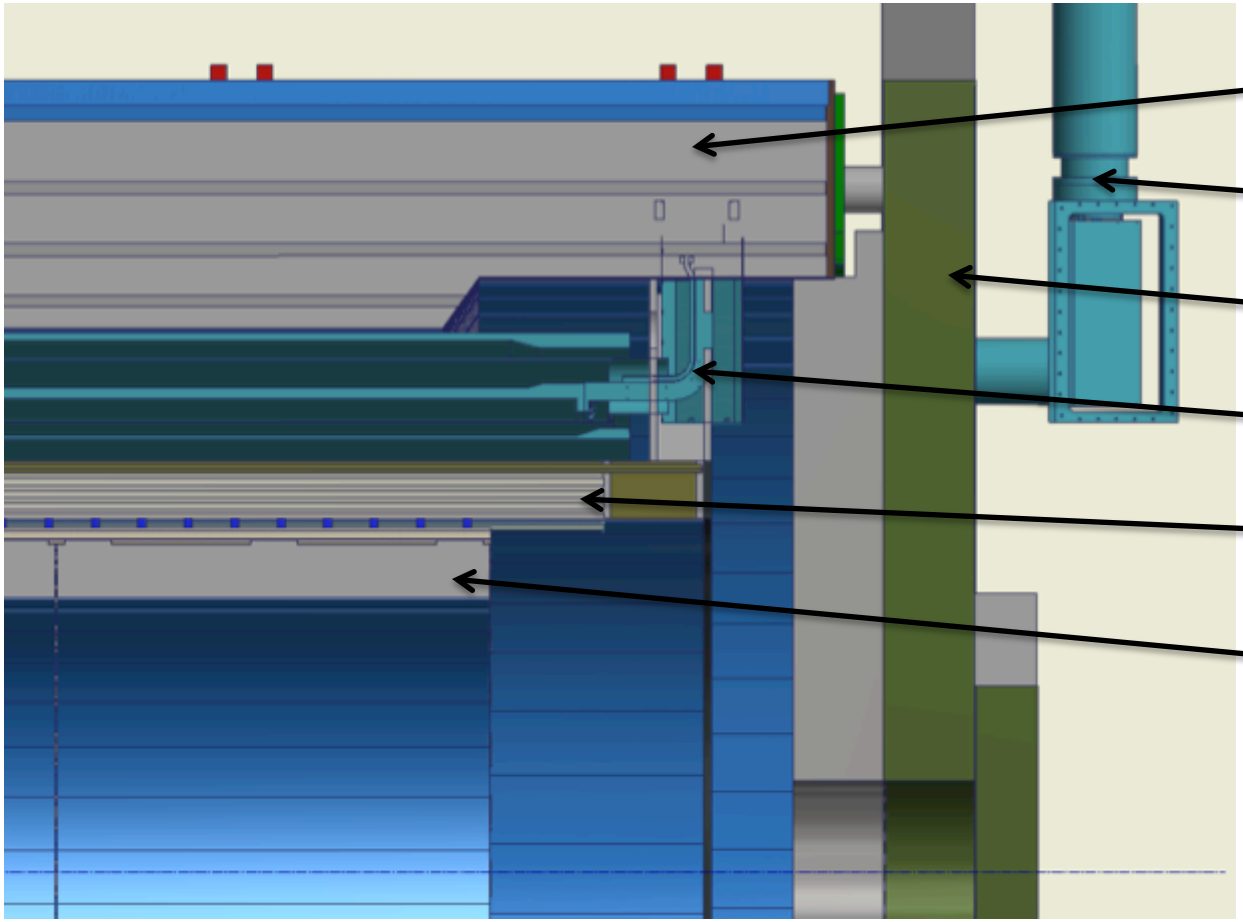




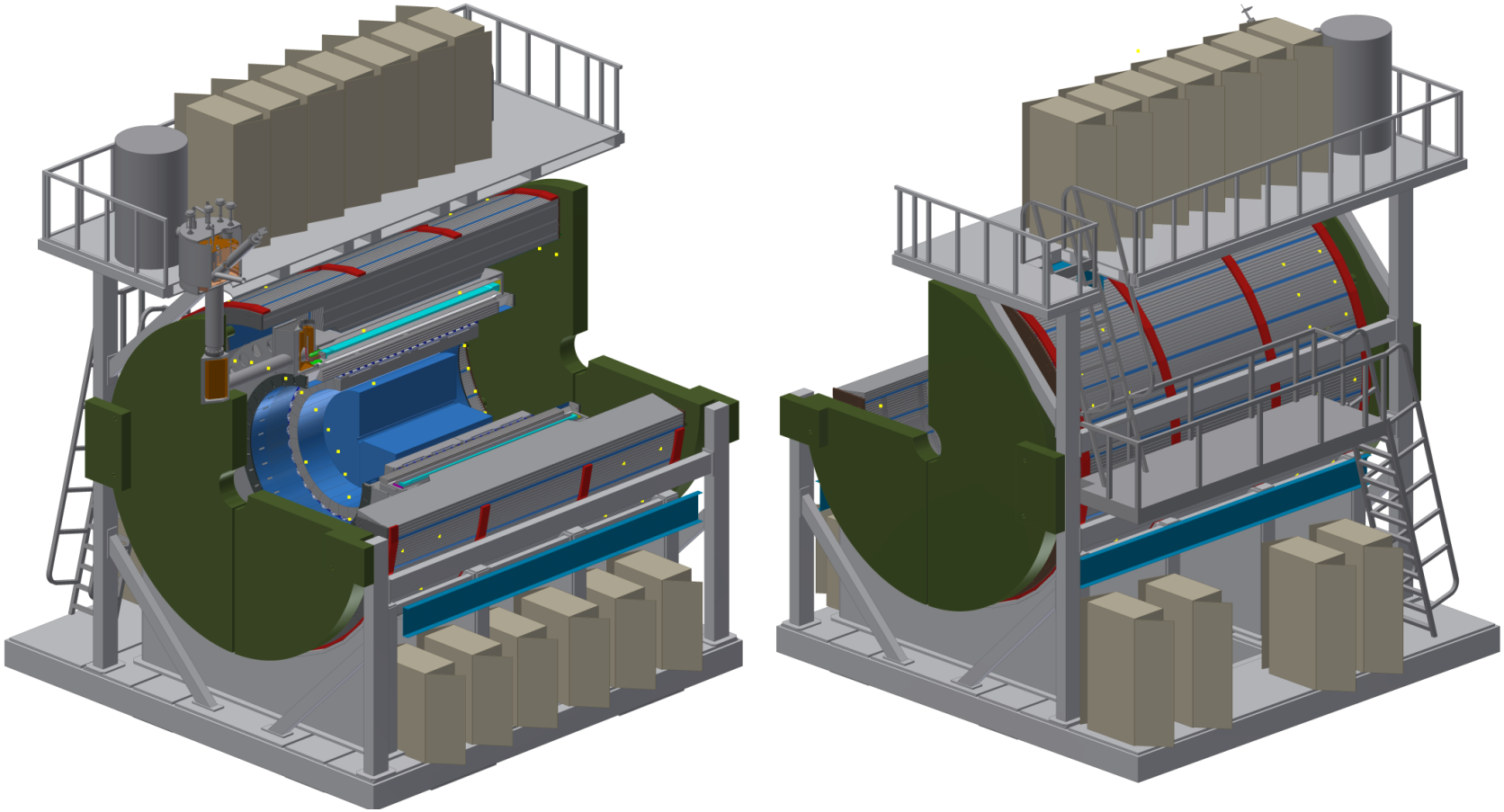



Columns supporting mid and upper platforms and flux return pole tips (not shown)
Rails supporting EMCal sectors from Inner HCal sectors
Inner HCal to Outer HCal support rings
Splice Plates Join Outer HCal sectors
Cradles (4) support Outer HCal
Not shown: Magnet mounting feet (12)
Roller bearings (4) support entire sPHENIX assembly, allow transport on sPHENIX rail system

Detector Cross Section



Integration



Integration Requirements

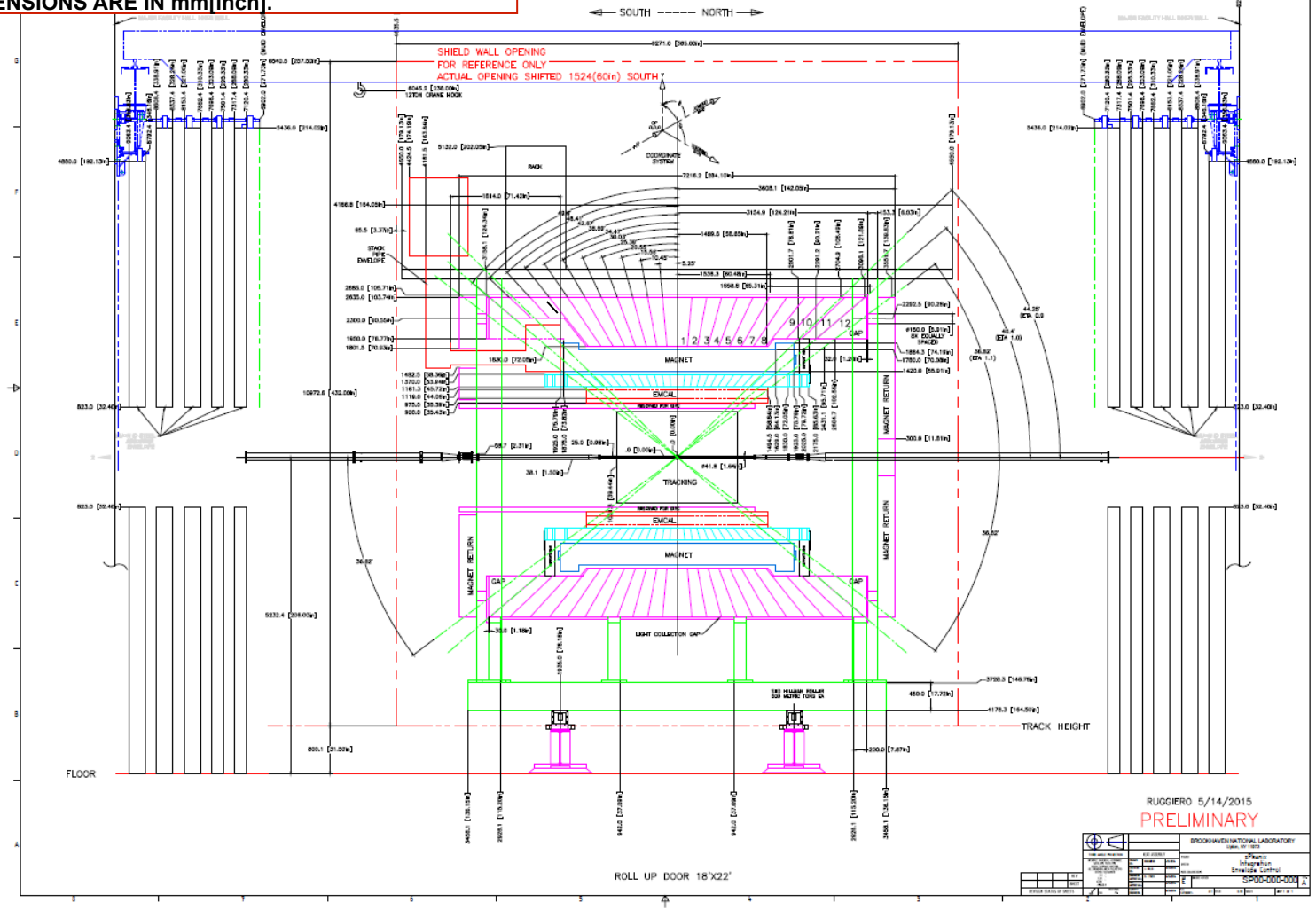
- Define overall envelope for sPhenix. (DWG# SP00-000-000).
  - Includes relevant existing infrastructure.
    - Tracks, IR walls, MuID, Crane hooks etc.
  - Envelope to include nuts bolts cables.
  - Only collaboration can change detector envelopes.
  - Stay clear regions between detectors for clearance & installation.
  - Ensure everything fits.
  - Define detector attachment points.

- Cable Management & Routing.
  - HV, LV, Signal & Cooling requirements
  - Provided to Integration by subsystem for inclusion in overall envelope.

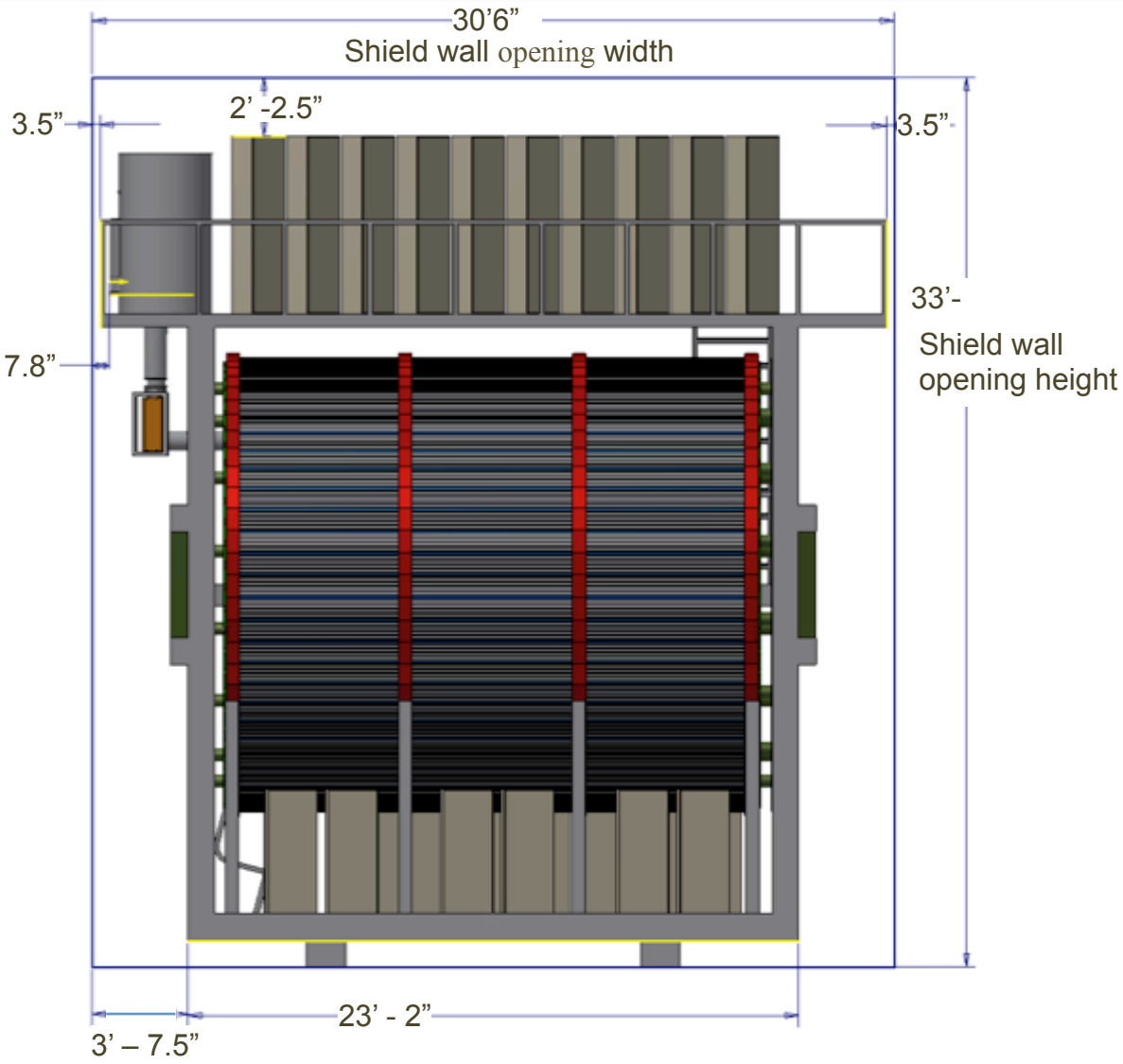
SPHENIX Envelope Control Drawing

NOTES:
1. NOTED DIMENSIONS ARE MAXIMUM SIZE.
   ALL SERVICES, NUTS, BOLTS & OTHER DETECTOR
   COMPONENTS SHALL NOT EXCEED THESE DIMENSIONS.
2. ALL DIMENSIONS ARE IN mm[inch].

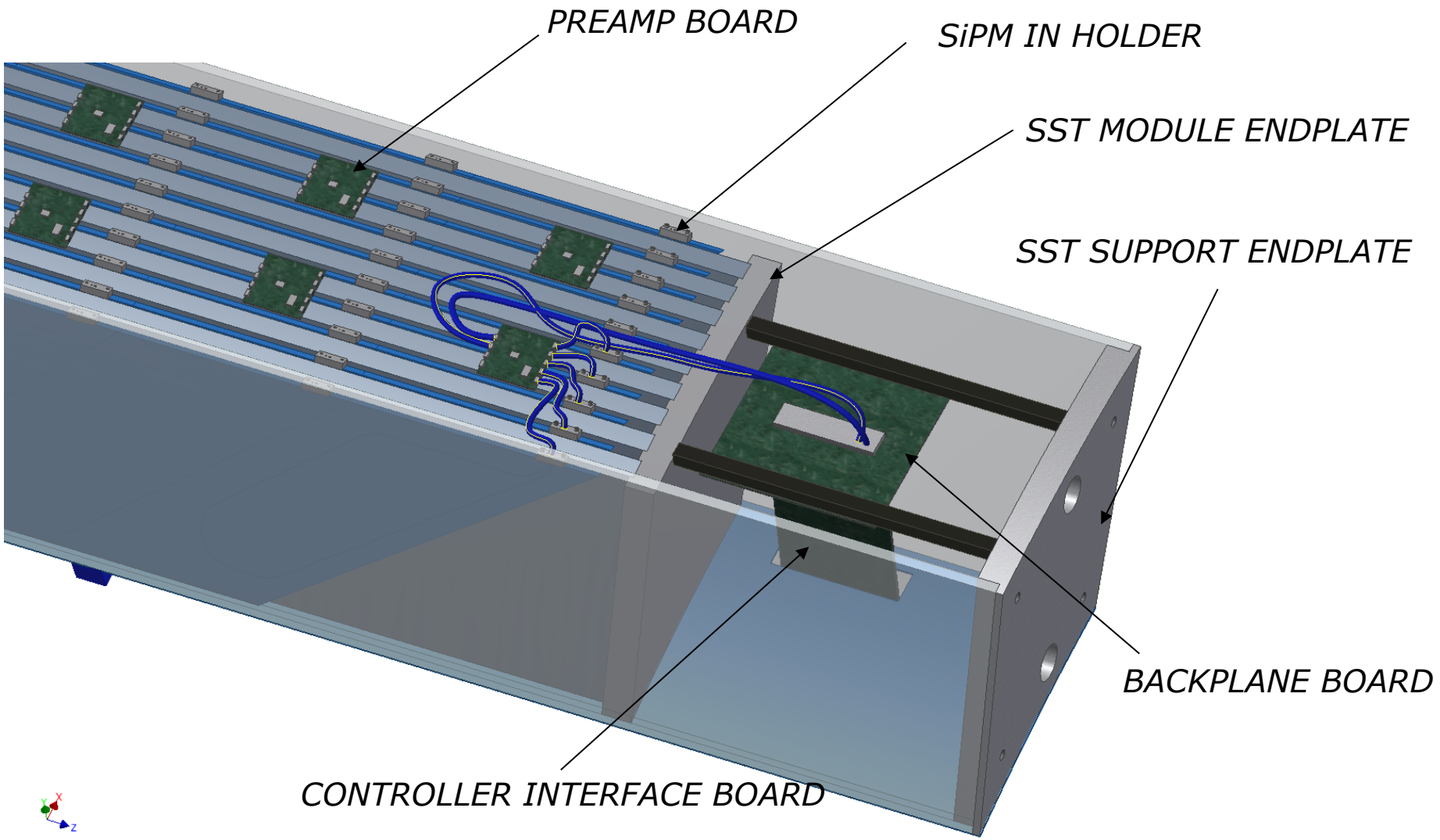
- AUTOCAD DRAWING
- SHOWS RELEVANT EXISTING INFRASTRUCTURE
- ONGOING EFFORT FOR SPHENIX



sPHENIX Overall Size and Shield Wall Opening

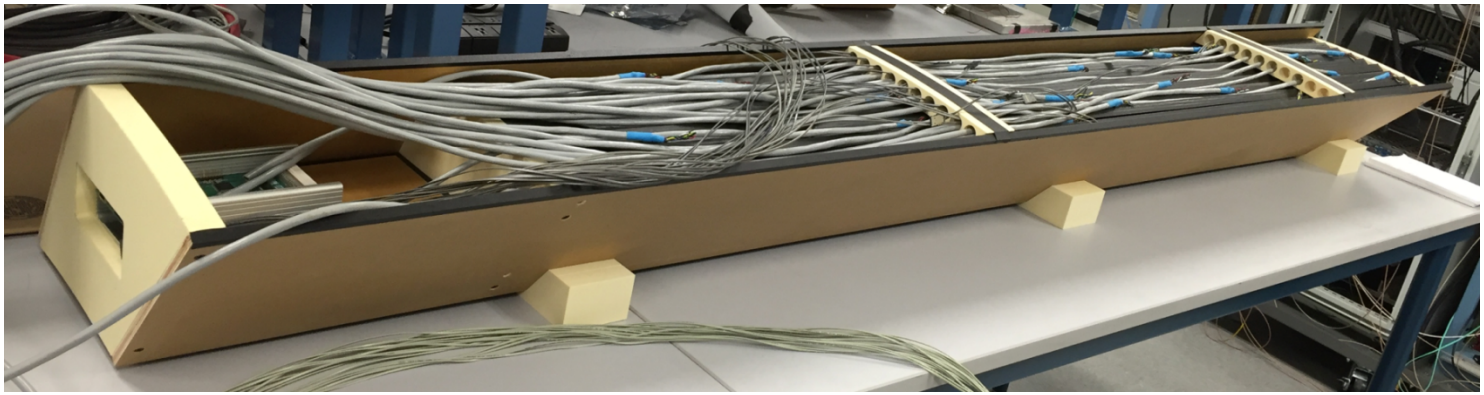


Inner HCAL Electroncis and Cable Routing

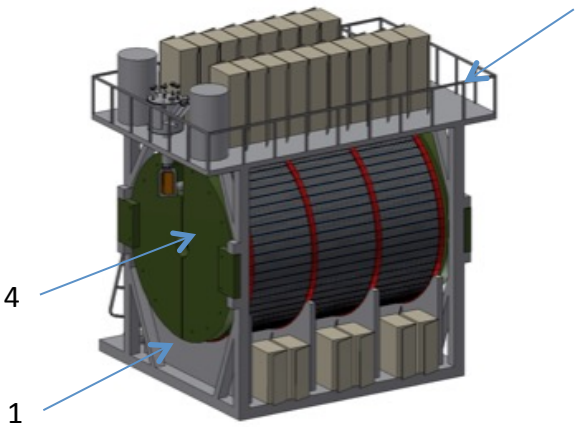


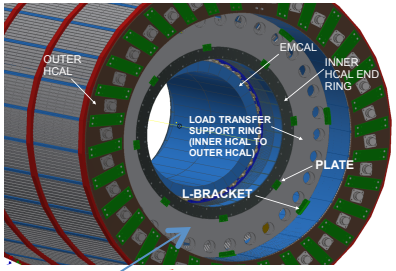
Allocating Space for Services

Inner HCal ½ sector Class II mockup
(dimensionally accurate/non-functional)



Infrastructure at 1008 for sPHENIX





Provide the detector Central Pedestal Support and Interconnecting hardware and support structures.

1. Support Pedestal, rollers, vertical and horizontal positioning assembly
2. End Ring for transitional support of the Inner Hcal Assembly to the Outer Hcal
3. Provide Electronics Bridge and Access Stairs
4. Magnet Pole Tips (Flux return endcaps)

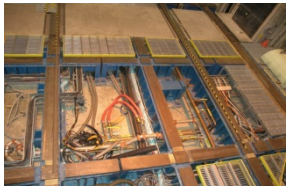
Existing Facility

Conventional Systems

- A/C Power
- Piping Supports (Cryo Pipe)
- Cable Tray
- Cooling Water
- Assembly Building/Control Room/Support Buildings
- HSSD, Leak Detection, Pass System, ODH
- Gas Distribution System (if required)

Existing Power

Existing Water System



Existing Distribution

Existing Power

Infrastructure Specification/Requirements

- **Pole Tips**
  - **204” OD x 24” ID x 12” Thick**
  - **Material – C1006 Magnet Steel**
  - **Detector Accessibility Requirements – Extended Maintenance (1week)**
- **Support Ring**
  - **Material – Stainless, 400 Series**
  - **Load Requirements – Transfer support loads from Inner HCal/EMCal to Outer Hcal**
- **Access Bridge**
  - **Accommodate Racks, Cryo Valve Box, Dewars (2), Controls**
  - **Design Floor Load Requirement – 150 PSF**
- **Cradle and Base**
  - **Design Load Requirement – 628T**
  - **Detector Verti./Horiz. Alignment Requirements - ±0.020 in. Vert/Horiz. , ±0.050 in. longitudinal. (proposed)**
  - **Detector Travel Speed Requirement – 1’/min. (proposed)**
- **Vacuum Pipe**
  - **Reuse of 31.5 inch long beryllium section**
- **Conventional Systems**
  - **Cooling Water – provide 2 gpm @ 50F Supply - 2 KW/Rack**
  - **HVAC – 68F/50%RH**
  - **Existing 480V, 1200A Buss**
  - **TPC Gas System (if required)**
- **Cryogenic systems and magnet support**
  - **Magnet power supply**
  - **Quench protection system**
  - **Cryo supply and controls. Integrated with the RHIC cryo system**

Summary

- **There is significant engineering progress in support of sPHENIX**
- **Thanks to the hard work of our team of engineers we have developed initial plans for PHENIX decommissioning, sPHENIX magnet testing/installation, integration, installation and infrastructure support.**
- **Plans are underway to take full advantage of the existing infrastructure in the 1008 complex for sPHENIX.**
- **Though a lot of detailed work remains, the work to date reveals no major engineering challenges for the integration, installation and infrastructure.**